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PATENT
Atty. Docket No. 30454-230
[P-3376]

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:

WILLIAM ERIC CORR

Serial No.: 09/344,169

Filed: June 24, 1999

For: DETERMINING TIMING OF
INTEGRATED CIRCUITS

Group Art Unit: 2123

Examiner: H. Jones

APPELLANT'S BRIEF ON APPEAL TO THE BOARD OF PATENT APPEALS AND INTERFERENCES

Assistant Commissioner for Patents
Washington, D.C. 20231

Dear Sir:

Appellant in the above-captioned patent application appeals the final rejection of claims 1 to 16, as set forth in the Office Action dated August 9, 2002, pursuant to the Notice of Appeal filed on October 18, 2002.

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I. REAL PARTY IN INTEREST

The real party in interest in this application is LSI Logic Corporation, pursuant to an assignment which was recorded at reel 010441, frame 0300 on December 2, 1999.

II. RELATED APPEALS AND INTERFERENCES

Appellant is not aware of any related appeals or interferences.

III. STATUS OF CLAIMS

Claims 1 to 16 have been finally rejected and are the subject matter of this Appeal. In accordance with 37 C.F.R. § 1.192(c)(9), a copy of the claims involved in this appeal is included in the Appendix attached hereto.

IV. STATUS OF THE AMENDMENTS

No amendments have been filed subsequent to the final rejection.

V. SUMMARY OF THE INVENTION

The present invention concerns techniques for determining the timing for a synchronous integrated circuit, in which each of multiple different signal paths ("victim wires") is examined with respect to the effects of nearby wires ("aggressor wires"), such as those wires that cross and/or run parallel to the victim wires, in order to determine the amount of perturbation the clocked signals in the aggressor wires would have on the victim wires. See page 4, second full paragraph, of the Specification.

For this purpose, using conventional (e.g., static) timing analysis, the aggressor wires are divided into a plurality of categories depending on the clocked timing of the aggressor wires in relation to the clocked timing of victim wires (see page 5, the first four full paragraphs, of the Specification). The effects of the aggressor wires can then be back-annotated into the conventional static timing analysis. See page 5, fifth full paragraph.

One significant difference between the present invention and the prior art is that in the present invention a user is allowed to select a mode of operation that is used to determine which categories of the aggressor wires will be considered, thereby allowing the user to trade run times against accuracy. See page 5, fifth full paragraph, and page 7, second and third paragraphs. The timing delay predictions are then modified based on the effects of the aggressor wires only in those categories corresponding to the mode of operation selected by the user. See page 7, second and third paragraphs.

In this manner, a user is provided with an effective and novel technique to trade off between run times and accuracy in predicting timing delays. Thus, for critical paths, the user might select a mode of operation that evaluates the effects of aggressor wires that have been determined not to be likely to affect the timing of a particular victim wire. On the other hand, for less critical paths, a mode of operation might be selected that would ignore the effects of such aggressor wires.

VI. ISSUES PRESENTED ON APPEAL

The issues presented are: (i) whether a proper objection has been made to the Abstract for allegedly adding new matter ("allowing a user to select a mode of operation") into the disclosure; (ii) whether a proper objection has been made to claims 9 and 10 based on an assertion that the meaning of the clause "perturb a given wire" allegedly is unknown in the context of the invention; (iii) whether a proper objection has been made to claim 6 for allegedly failing to further limit the subject matter of claims 1 and 3; (iv) whether a proper objection has been made to the claims for reciting "allowing a user to select a mode of operation" rather than reciting that the user actually selects a mode of operation; (v) whether claims 1 to 16 are properly rejected under 35 U.S.C. § 112, first paragraph, for allegedly failing to provide an enabling or adequate disclosure with respect to calculation of crosstalk, the relationship between the timing and crosstalk, types of signals carried on the aggressor wires, timing margins and scaling; (vi) whether claims 1 to 16 are properly rejected under 35 U.S.C. § 112, first paragraph, based on an assertion that "allowing a user to select a mode of operation"

allegedly is not supported in the original Specification; (vii) whether claims 1 to 16 are properly rejected under 35 U.S.C. § 112, second paragraph, based on an assertion that the meaning of the limitation "allowing a user to select a mode of operation" allegedly is unknown; (viii) whether claims 1 to 16 are properly rejected under 35 U.S.C. § 102(b) over an article titled "Minimum Crosstalk Channel Routing (Gao) or over U.S. Patent 5,596,506 (Petschauer); and (ix) whether claims 1 to 16 are properly rejected under § 102(e) over U.S. Patent 5,983,006 (Carlson).

VII. GROUPING OF THE CLAIMS

In the Office Action, the Examiner grouped all of the pending claims together for purposes of the prior art rejections. However, for purposes of the present appeal, Appellant believes that the claims are more appropriately grouped as follows:

GROUP 1: Claims 1, 2, 7 and 8

GROUP 2: Claim 3

GROUP 3: Claim 4

GROUP 4: Claim 5

GROUP 5: Claim 6

GROUP 6: Claims 9 and 10

GROUP 7: Claims 11 and 14

GROUP 8: Claims 12 and 15

GROUP 9: Claims 13 and 16

It is therefore Appellant's intent that, for purposes of the § 102 rejections, the claims in each of the foregoing groups will stand or fall together, except that whenever any claim in one group depends (whether directly or indirectly) from a claim that ultimately is determined to be allowable over the applied art, such dependent claim also should be allowed over the applied art for at least the same reasons.

VIII. ARGUMENT

OBJECTION TO ABSTRACT

In the final rejection, objection was made to the Abstract under 35 U.S.C. § 132 for allegedly adding new matter into the disclosure, based on the argument that “allowing a user to select a mode of operation” allegedly is not supported in the original Specification. However, it is noted that support for this clause is found in the original Specification on page 5, in the fifth full paragraph. That paragraph states in pertinent part, “The degree of effect very likely... possible could be selected by the user to trade run times against accuracy.” In addition, use of the selected mode is described on page 7, second paragraph, of the original Specification. In view of these portions of the Specification, this objection is believed to be improper.

OBJECTIONS TO CLAIMS 1 to 16

In the final rejection, objection was made to claims 1 to 16. The grounds for these objections and the response thereto are as follows.

Objection was made to claims 9 and 10 because the meaning of the clause “perturb a given wire” allegedly is unknown in the context of the invention. In this regard, both of claims 9 and 10 depend (directly or indirectly) from claim 8, which recites means for determining the amount of electromagnetic coupling between aggressor wires and victim wires and means for dividing the aggressor wires into a plurality of categories depending on the clocked timing of the aggressor wires in relation to the clocked timing of the victim wires. In this context, it is clear that the likelihood of one wire perturbing another wire clearly refers to perturbation through electromagnetic coupling. In fact, Appellant is unaware of any other mechanism through which one wire may perturb another wire. Accordingly, the meaning of the recited expression is believed to be clear and the objection to these claims therefore is believed to be improper.

Objection was made to claim 6 as allegedly failing to further limit the subject matter of claims 1 and 3. In this regard, independent claim 1 recites the features of dividing aggressor wires into a plurality of categories, allowing a user to select a mode of operation, and modifying certain predictions based on the effects of the aggressor wires only in those categories corresponding to the mode of operation selected by the user. Claim 3, in turn, recites the additional feature that the aggressor wires are divided into three categories of likely, possible for unlikely to affect the timing of the victim wire. Claim 6 then further limits claim 3 by reciting that the mode of operation selected by the user causes the effects of the aggressor wires in none of the categories to be taken into account. In other words, according to claim 6, the selected mode is such that no modification is performed in step (6) of claim 1. Thus, claim 6 is believed to further limit claims 1 and 3.

The fact that the narrowing limitation results in no actual modification being performed in step (6) does not negate this fact. Appellant disagrees with the Examiner's assertion that step (6) of claim 1 is inoperative. Even though no modification is performed in that step, the step still must evaluate the mode of operation in order to determine that no modification is to be performed. Accordingly, this objection also is believed to be improper.

Objection was made to the claims for reciting "allowing a user to select a mode of operation" rather than reciting that the user actually selects a mode of operation. However, claims 1 and 8 are directed to a method of determining timing, and the steps of claim 1 and means of claim 8 used for determining timing are not intended to be performed by the user, even though certain of such steps are based on the mode selected by the user. Accordingly, amending claims 1 and 8 as suggested by the Examiner actually would result in an inconsistency. For this reason, this objection also is believed to be improper.

SECTION 112, FIRST PARAGRAPH, REJECTIONS

Claims 1 to 16 were rejected under 35 U.S.C. § 112, first paragraph, as allegedly containing subject matter which was not described in the Specification in such a way as to enable one skilled in the art to make and/or use the invention. Specifically, the Examiner asserts that there is insufficient detail in the Specification pertaining to crosstalk, the relationship between the timing and crosstalk, types of signals carried on the aggressor wires, timing margins and scaling. In response, Appellant notes that the present invention does not depend upon any specific techniques for forming timing delay predictions and for determining an amount of electromagnetic coupling. Rather, the present invention provides techniques that may be utilized in conjunction with a wide variety of different conventional methods for performing timing delay predictions and determining crosstalk.

To the extent that the relevant claimed subject matter is not expressly disclosed in Appellant's Specification, it is fully described in the prior art, including in the Gao, Petschauer and Carlson references cited by the Examiner. Specifically, each of these particular references discusses electromagnetic coupling and conventional integrated circuit timing analysis. This fact is mentioned in the last full paragraph of page 7 of the Specification and previously has been pointed out to the Examiner. It is noted that the Examiner has not disagreed with Appellant's assertion in this regard, but rather appears to believe that such an assertion amounts to an improper incorporation by reference into Appellant's Specification.

In response, MPEP § 2164.01, quoting United States v. Teletronics, Inc., 857 F.2d 778, 785, 8 USPQ2d 1217, 1223 (Fed. Cir. 1988), states, "The test of enablement is whether one reasonably skilled in the art could make or use the invention from the disclosures in the patent *coupled with information known in the art* without undue experimentation [emphasis added]." The same MPEP section then goes on to state that, "A patent need not teach, and preferably omits, what is well known in the art." [citations omitted]

This is precisely what has been done in the present case. Any of the prior art techniques for forming timing delay predictions and for determining an amount of electromagnetic coupling may be utilized in Appellant's invention. Accordingly, this rejection is believed to be improper.

The Examiner also rejects claims 1 to 16 under 35 U.S.C. § 112, first paragraph, as allegedly containing subject matter not adequately described in the Specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor, at the time the application was filed, had possession of the claimed invention. While the grounds for this rejection are not entirely clear, this rejection appears to be related to the preceding rejection. In particular, the Examiner appears to be asserting that Appellant's preceding argument that one of ordinary skill in the art would know how to perform certain aspects of the claimed subject matter based on an awareness of the available prior art somehow adds new matter to the Specification. Appellant fails to understand this rejection, as Appellant's argument alone cannot effect an amendment to his Specification.

The Examiner also includes in the final rejection an apparently related discussion of incorporation by reference. However, Appellant has not attempted to incorporate anything by reference. Rather, as noted above, it is entirely permissible to rely upon existing prior art to show that a disclosure is in fact enabling.

While the Examiner is unclear as to the specific portions of the claims that allegedly are not adequately supported by the original Specification, Appellant notes that the present claims are very similar to the original claims. In addition, other portions of the original Specification repeatedly reference perturbation coupling, coupling capacitance and other similar terms. Appellant therefore believes that the pending claims are fully supported by the original Specification and that the present rejection is improper.

In his discussion, the Examiner also implies that supporting structure for the means-plus-function claims in the present application is not described in Appellant's

Specification. However, such structure clearly is described, e.g., in the only full paragraph on page 8 of the Specification.

Claims 1 to 16 also were rejected under 35 U.S.C. § 112, first paragraph, based on the argument that "allowing a user to select a mode of operation" allegedly is not supported in the original Specification. Support for this claim limitation is found in the Specification on page 5, at the fifth full paragraph. That paragraph states in pertinent part, "The degree of effect very likely... possible could be selected by the user to trade run times against accuracy." In addition, subsequent use of the selected mode is described on page 7, second paragraph, of the original Specification. Thus, the substance of the existing claims clearly is supported in the original Specification. As a result, this rejection also is believed to be improper.

SECTION 112, SECOND PARAGRAPH, REJECTIONS

Claims 1 to 16 also were rejected under 35 U.S.C. § 112, second paragraph, on the grounds that the meaning of the limitation "allowing a user to select a mode of operation" is unknown. With regard to the substance of the rejection, Appellant points out that step (6) of claim 1 and means (6) of claim 8 clearly indicate that the mode selected by the user is used for designating the categories of aggressor wires to be considered in modifying the predictions performed in step (1), or by means (1). Accordingly, the meaning of the referenced clause is believed to be clear, and therefore this rejection also is believed to be improper.

PRIOR ART CLAIM REJECTIONS

The criteria for showing anticipation under § 102 have been set forth as follows. "For a prior art reference to anticipate in terms of 35 U.S.C. § 102, every element in the claimed invention must be shown in a single reference." In re Bond, 15 USPQ2d 1566, 1567 (Fed. Cir. 1990) (quoting Diversitech, 7 USPQ2d 1315). In addition, that single reference must arrange the elements exactly as in the claim under review, although identity of terminology is not required. Id.

It also has been held that "The identical invention must be shown in as complete detail as is contained in the . . . claim." Richardson v. Suzuki Motor Co., 868 F.2d 1226, 1236, 9 U.S.P.Q.2d 1913, 1920, (Fed. Cir. 1989).

Group 1 Claims

Independent claims 1 and 8 are directed to a method for determining the timing for a synchronous integrated circuit, the circuit including a multiplicity of clocked elements interconnected by signal paths. Predictions are formed for timing delays in the signal paths in the integrated circuit. A first such path is selected, wires are traced in the integrated circuit forming the path (hereinafter referred to as victim wires), and adjacent and crossing wires thereto (hereinafter referred to as aggressor wires) are determined. For each aggressor wire, the amount of electromagnetic coupling to the victim wires of the first path is determined. The aggressor wires are divided into a plurality of categories depending on the clocked timing of the aggressor wires in relation to the clocked timing of the victim wires. A user is allowed to select a mode of operation, and for each victim wire, the timing delay predictions are modified based on the effects of the aggressor wires only in those categories corresponding to the mode of operation selected by the user.

The foregoing combination of features is not disclosed by the applied art. In particular, the applied art is not seen to say anything at all about allowing a user to select a mode of operation that controls what categories of aggressor wires will be utilized in modifying previously formed timing delay predictions. Moreover, the Examiner has not even alleged that any of the applied art discloses this feature of the invention. For at least this reason, the Group 1 claims are believed to be allowable over the applied art.

Group 2 Claim

Claim 3 depends from independent claim 1 (in the Group 1 claims) and recites the further limitation that the aggressor wires are divided into three categories of likely,

possible or unlikely to affect the timing of the victim wire. This additional limitation is not disclosed by the applied art. Despite rejecting this claim over each of Gao, Petschauer and Carlson, the Examiner has cited only Carlson as showing this feature of the invention. Although it is not entirely clear, the Examiner appears to be referring to claim 7 of Carlson as showing this feature of the invention. However, this portion of Carlson does not contain any disclosure whatsoever that aggressor wires are divided into three categories of likely, possible or unlikely to affect the timing of a victim wire. Moreover, Appellant has reviewed the remainder of Carlson and is not able to find this feature anywhere in that reference. For at least this additional reason, claim 3 is believed to be allowable over the applied art.

Group 3 Claim

Claim 4 depends from claim 3 (the Group 2 claim) and recites the further limitation that the mode of operation selected by the user causes only the effects of the aggressor wires in the likely category to be taken into account. This additional limitation is not disclosed by the applied art. Despite rejecting this claim over each of Gao, Petschauer and Carlson, the Examiner has cited only Carlson as showing this feature of the invention. However, Appellant has reviewed Carlson in detail and is unable to find any disclosure that the mode of operation selected by the user causes only the effects of the aggressor wires in the likely category (among the three categories) to be taken into account. For this additional reason, claim 4 is believed to be allowable over the applied art.

Group 4 Claim

Claim 5 depends from claim 3 (the Group 2 claim) and recites the further limitation that the mode of operation selected by the user causes only the effects of the aggressor wires in the likely and possible categories to be taken into account. This additional limitation is not disclosed by the applied art. Despite rejecting this claim over each of Gao, Petschauer and Carlson, the Examiner has cited only Carlson as showing this feature of the invention. However, Appellant has reviewed Carlson in

detail and is unable to find any disclosure that the mode of operation selected by the user causes only the effects of the aggressor wires in the likely and possible categories (among the three categories) to be taken into account. For this additional reason, claim 5 is believed to be allowable over the applied art.

Group 5 Claim

Claim 6 depends from claim 3 (the Group 2 claim) and recites the further limitation that the mode of operation selected by the user causes the effects of the aggressor wires in none of the categories to be taken into account. This additional limitation is not disclosed by the applied art. In fact, despite rejecting this claim over each of Gao, Petschauer and Carlson, the Examiner has not pointed out where in any of those three references this feature of the invention is disclosed. For this additional reason, claim 6 is believed to be allowable over the applied art.

Group 6 Claim

Claims 9 and 10 depend from the Group 1 claims and recite the further limitation that the aggressor wires are divided into the plurality of categories based on a likelihood that they will perturb a given victim wire. This additional limitation is not disclosed by the applied art. In fact, despite rejecting this claim over each of Gao, Petschauer and Carlson, the Examiner has not pointed out where in any of those three references this feature of the invention is disclosed. For this additional reason, claims 9 and 10 are believed to be allowable over the applied art.

Group 7 Claims

Claims 11 and 14 depend from the Group 1 claims and recite the further limitation that the predictions are modified by adding a margin of error to the timing delay predicted for a corresponding victim wire. This additional limitation is not disclosed by the applied art. In fact, despite rejecting this claim over each of Gao, Petschauer and Carlson, the Examiner only appears to point to Figure 8 of Petschauer and claim 2 of Carlson as showing this feature of the invention. While Figure 8 of

Petschauer illustrates a noise margin and claim 2 of Carlson mentions adding a set-up time margin for a victim signal, nothing in Petschauer or Carlson indicates that a margin is added only for aggressor wires in categories corresponding to a mode of operation selected by a user, as is the case in the present claims. For this additional reason, claims 11 and 14 are believed to be allowable over the applied art.

Group 8 Claim

Claims 12 and 15 depend from the Group 7 claims and recite the further limitation that the margin of error depends upon a number of the aggressor wires in each of the categories corresponding to the mode of operation selected by the user. This additional limitation is not disclosed by the applied art. In fact, despite rejecting this claim over each of Gao, Petschauer and Carlson, the Examiner does not point to any portion of the applied references as showing this specific feature of the invention. For this additional reason, claims 12 and 15 are believed to be allowable over the applied art.

Group 9 Claim

Claims 13 and 16 depend from the Group 7 claims and recite the further limitation that the margin of error depends upon the amount of electromagnetic coupling of the aggressor wires in each of the categories corresponding to the mode of operation selected by the user. This additional limitation is not disclosed by the applied art. In fact, despite rejecting this claim over each of Gao, Petschauer and Carlson, the Examiner does not point to any portion of the applied references as showing this specific feature of the invention. For this additional reason, claims 13 and 16 are believed to be allowable over the applied art.

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CONCLUDING REMARKS

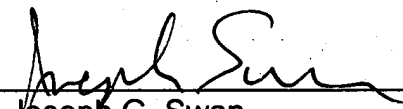
In view of the foregoing remarks, Appellant respectfully requests that all pending objections and rejections be reversed and a Notice of Allowance issued.

Respectfully submitted,

MITCHELL, SILBERBERG & KNUPP LLP

Dated: December 18, 2002

By


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APPENDIX

Claims on Appeal

1. A method of determining the timing for a synchronous integrated circuit, the circuit including a multiplicity of clocked elements interconnected by signal paths, the method comprising:
 - 1) Forming predictions for timing delays in said signal paths in the integrated circuit;
 - 2) Selecting a first such path, tracing wires in the integrated circuit forming the path, hereinafter referred to as victim wires, and determining adjacent and crossing wires thereto, hereinafter referred to as aggressor wires;
 - 3) For each aggressor wire, determining the amount of electromagnetic coupling to the victim wires of the first path;
 - 4) Dividing the aggressor wires into a plurality of categories depending on the clocked timing of the aggressor wires in relation to the clocked timing of the victim wires;
 - 5) Allowing a user to select a mode of operation; and
 - 6) For each victim wire, modifying the predictions formed in step (1) based on the effects of the aggressor wires only in those categories corresponding to the mode of operation selected by the user.
2. A method according to claim 1, wherein step (3) is carried out taking into account one or more of the following factors:
 - a) whether the aggressor wire crosses or runs parallel to the victim wire;
 - b) the signal strengths in the victim and aggressor wires;
 - c) the layers in the integrated circuit which the wires are disposed; and
 - d) what type of signal is carried on the aggressor wire.
3. A method according to claim 1, wherein the aggressor wires are divided into three categories of likely, possible or unlikely to affect the timing of the victim wire.

4. A method according to claim 3, wherein the mode of operation selected by the user causes only the effects of the aggressor wires in the likely category to be taken into account.
5. A method according to claim 3, wherein the mode of operation selected by the user causes only the effects of the aggressor wires in the likely and possible categories to be taken into account.
6. A method according to claim 3, wherein the mode of operation selected by the user causes the effects of the aggressor wires in none of the categories to be taken into account.
7. A method according to claim 3, wherein the effects of aggressor wires in any category are scaled according to their respective electrical signal coupling with the victim wire.
8. An apparatus for determining the timing of a synchronous integrated circuit, the circuit including a multiplicity of clocked elements interconnected by signal paths, the apparatus comprising:
 - 1) Means for forming predictions for timing delays in said signal paths in the integrated circuit;
 - 2) Means for selecting a first such path, tracing wires in the integrated circuit forming the path, hereinafter referred to as victim wires, and determining adjacent and crossing wires thereto, hereinafter referred to as aggressor wires;
 - 3) Means for determining the amount of electromagnetic coupling, for each aggressor wire, to the victim wires of the first path;
 - 4) Means for dividing the aggressor wires into a plurality of categories depending on the clocked timing of the aggressor wires in relation to the clocked timing of the victim wires;

- 5) Means for allowing a user to select a mode of operation; and
 - 6) Means for modifying the predictions formed in step (1), for each victim wire, based on the effects of the aggressor wires only in those categories corresponding to the mode of operation selected by the user.
9. A method according to claim 1 wherein the aggressor wires are divided into the plurality of categories in step (4) based on a likelihood that they will perturb a given victim wire.
10. An apparatus according to claim 8 wherein the aggressor wires are divided into the plurality of categories by said means (4) based on a likelihood that they will perturb a given victim wire.
11. A method according to claim 1 wherein the predictions are modified in step (6) by adding a margin of error to the timing delay predicted for a corresponding victim wire in step (1).
12. A method according to claim 11 wherein the margin of error depends upon a number of the aggressor wires in each of the categories corresponding to the mode of operation selected by the user.
13. A method according to claim 11 wherein the margin of error depends upon the amount of electromagnetic coupling of the aggressor wires in each of the categories corresponding to the mode of operation selected by the user.
14. An apparatus according to claim 8 wherein the predictions are modified in step (6) by adding a margin of error to the timing delay predicted for a corresponding victim wire by said means (1).

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15. An apparatus according to claim 14 wherein the margin of error depends upon a number of the aggressor wires in each of the categories corresponding to the mode of operation selected by the user.

16. An apparatus according to claim 14 wherein the margin of error depends upon the amount of electromagnetic coupling of the aggressor wires in each of the categories corresponding to the mode of operation selected by the user.